

COMMUNICATION CONNECTION MERGE METHOD

AND NODE TO BE USED THEREFOR

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates generally to a communication connection merge method and a node to be employed therein. Particularly, the invention relates to a communication connection merge method and node to be employed therein, which merges a plurality of communication connection set in a connection-oriented network during communication with simultaneously updating collateral parameter on a common path performing merging.

Description of the Related Art

Conventionally, a communication connection merge method and a node to be employed in the same is used for merging communication connections which make transfer path from a merge point to an egress label switching router (LSR) common, upon setting a label switching path (LSP) in a MultiProtocol Label Switching (MPLS) network as disclosed in Internet Draft, draft-ietf-mpls-arch-06.txt, August, 1999 and Internet Draft, draft-ietf-mpls-ldp-06.txt, October, 1999, for example.

Here, merge means consolidating a plurality of transfer paths into a single transfer path at a mid-way. In a path from a merge point to an egress LSR, the same transfer path identifier (here, a label of MPLS) is used for the packet. By performing merging, number of

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transfer label of LSR can be reduced to contribute for operation of a large-scale network.

Next, the prior art will be discussed with assumption that connection-oriented network being MPLS network, communication connection being LSP and node being LSR. Referring to Fig. 9, the MPLS network 1 is constructed with LSRs 101 to 104. Respective LSR 101 to 104 are connected through links 201 to 203. Data is exchanged through these links 201 to 203. On the other hand, an LSP 301 routed from the LSR 101 to the LSR 103 via the LSR 102 is present.

Here, consideration is given for the case that new LSP is established from the LSR 104 to the LSR 103, at first, the LSR 104 feeds an LSP setup request 401 for the LSR 103 to the LSR 102 using an LSP setting protocol. The LSR 102 receiving the LSP setup request 401 makes judgment whether or not LSP to be merged to the LSR 103 is present. If present, merging is performed. Here, since the LSP 301 which makes the path to an egress router in common, is already present, merging can be performed.

Upon performing merging, setting of LSP is not requested beyond the LSR 102 (namely to the LSR 103), an LSP setup response 402 is returned to the LSR 104. Then, with taking the LSR 104 as starting point, an LSP 302 to be merged to the LSP 301 is set in the LSR 102.

In the conventional communication connection merge method, collateral parameter (called parameter), such as request bandwidth

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or the like owned by the LSP cannot be merged upon performing merging. This is because the merging is performed without modifying the parameter of existing LSP.

As an example of such parameter, there are parameter relating to traffic, such as request bandwidth, delay or the like, parameter relating to policy, such as Virtual Private Network (VPN) identifier, preference or the like.

On the other hand, in the conventional communication connection merge method, once merging is performed, the merged LSP cannot be branched at the mid-way. Therefore, even if the parameter, such as request bandwidth or the like owned by the LSP could be merged together, the range of application is limited to the case where transfer path to the egress LSR can be common. For example, even if the most portion of the transfer path is common, merging cannot be performed if the egress LSR is different.

SUMMARY OF THE INVENTION

Therefore, the present invention has been worked out for solving the problem. It is an object of the present invention to provide a communication connection merge method and a node to be employed in the same, which can merge parameter of LSP, such as request bandwidth or the like, upon performing merging.

Another object of the present invention to provide a communication connection merge method and a node to be employed in the same, which

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can merge the parameter of the LSP together and can branch the LSP once merged.

According to the first aspect of the present invention, a communication connection merge method performing merge process for consolidating a plurality of communication connection of a connection-oriented network at a node on the way of transfer route into a common communication connection, comprises:

a step of making judgment of possibility to have a common transfer route from a node to merge to an egress node upon merging new communication connection on setting for existing communication connection;

a step of modifying collateral parameter of the existing communication connection which is judged to merge the new communication connection for enabling accommodation of the new communication connection in the existing communication connection; and

a step of performing merge after modification of parameter of the existing communication connection.

According to the second aspect of the present invention, a communication connection merge method performing merge process for consolidating a plurality of communication connection of a connection-oriented network at a node on the way of transfer route into a common communication connection, comprises:

a step of making judgment whether a tunneling communication

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a step of modifying collateral parameter of the tunneling communication connection to merge the new communication connection for enabling accommodation of the new communication connection in the tunneling communication connection; and

According to the third aspect of the present invention, a communication connection merge method performing merge process for consolidating a plurality of communication connection of a connection-oriented network at a node on the way of transfer route into a common communication connection, comprising:

a step of newly setting a tunneling communication connection capable of accommodating collateral parameter of the existing communication connection and the new communication connection in a section where the existing communication connection and the new communication connection have a common transfer route upon merging

new communication connection on setting for existing communication connection; and

a step of performing merge the existing communication connection and the new communication connection on the tunneling communication connection in a condition to be branched at a terminal point node after modification of parameter of the existing communication connection.

According to the fourth aspect of the present invention, a node performing merge process for consolidating a plurality of communication connection of a connection-oriented network at a node on the way of transfer route into a common communication connection, comprises:

means for making judgment of possibility to have a common transfer route from a node to merge to an egress node upon merging new communication connection on setting for existing communication connection;

~~means for modifying collateral parameter of the existing communication connection which is judged to merge the new communication connection for enabling accommodation of the new communication connection in the existing communication connection; and~~

means for performing merge after modification of parameter of the existing communication connection.

According to the fifth aspect of the present invention, a node

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means for performing merge the existing communication connection and the new communication connection on the tunneling communication connection in a condition to be branched at a terminal point node after modification of parameter of the existing communication connection.

For modifying parameter of the existing label switched path, negotiation has to be performed for all of label switching routers

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On the other hand, if modification of the parameter is not possible, merge is not performed to send the label switched path setup request to the downstream side label switching router for setting another label switched path. By employing such method, parameter, such as requested bandwidth or the like can be merged together with the label switched path, upon merging.

In the portion where the tunneling label switched path is used as a part of transfer route of the label switched path, label stack of the multi-protocol label switching is employed for the transfer

packet to add the label of the tunneling label switched path in front of the label of the label switched path. In the tunneling label switched path, a plurality of the label switched path can be accommodated. In the portion other than the tunneling label switched path, the routes of the accommodated label switched paths are not necessarily the same.

By employing such method, it becomes possible to merge the parameter of label switched path together with the label switched path, and in conjunction therewith, the label switched path once merged can be branched on the way.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given hereinafter and from the accompanying drawings of the preferred embodiment of the present invention, which, however, should not be taken to be limitative to the invention, but are for explanation and understanding only.

In the drawings:

Fig. 1 is an illustration for explaining the first embodiment of a communication connection merge system according to the present invention;

Fig. 2 is a flowchart showing an operation in an LSR 102 in the first embodiment of the communication connection merge system according to the present invention;

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Fig. 3 is a flowchart showing an operation in an LSR 103 in the first embodiment of the communication connection merge system according to the present invention;

Fig. 4 is an illustration for explaining the second embodiment of a communication connection merge system according to the present invention;

Fig. 5 is an illustration for explaining the second embodiment of a communication connection merge system according to the present invention;

Fig. 6 is an illustration for explaining a structure of a MPLS packet;

Fig. 7 is a flowchart showing an operation in an LSR 107 in the second embodiment of the communication connection merge system according to the present invention;

Fig. 8 is an illustration for explaining the second embodiment of a communication connection merge system according to the present invention; and

Fig. 9 is an illustration for explaining the conventional merge operation in the MPLS network.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be discussed hereinafter in detail in terms of the preferred embodiment of the present invention with

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Fig. 2 is a flowchart showing an operation in an LSR 102 in the first embodiment of the communication connection merge system according to the present invention, and Fig. 3 is a flowchart showing an operation in an LSR 103 in the first embodiment of the communication connection merge system according to the present invention. The operation of the first embodiment of the present invention will be discussed with reference to Figs. 1 to 3.

At first, consideration will be given for the case where a new

LSP is established from the LSR 104 to the LSR 103 via the LSR 102. Here, the LSP to be newly set has parameters, such as request bandwidth or the like. The LSR 102 receives an LSP setup request 401 transmitted from the LSR 104 (step S1 of Fig. 2).

The LSR 102 receiving the LSP setup request 401 checks whether the LSP having a common route to the egress LSR 103 from the LSR 102 (step S2 of Fig. 2). When such LSP is present, merging is not performed and the process is transit to a procedure for setting the LSP (step S12 of Fig. 2).

11/06 A¹⁰ ✓ As a result of judgment at step S2, if LSP, in which a route from the LSR 102 to the LSR 103 is common. is present, check is performed whether the existing LSP have the same kind of parameter as that of the LSP to be newly established (step S3 of Fig. 2). If the existing route does not have the same kind of parameter as that of the LSP to be newly established. merge cannot be performed. Therefore, the process is advanced to the LSP establishing procedure without performing merge (step S12 of Fig. 2).

11/05 A¹¹ ✓ As a result of judgment at step S3, it is assumed that the LSP 301 having the same kind of parameter as the LSP to be newly set, is present. In this case, check is performed in the LSR 102 whether or not the parameter of the LSP 301 can be modified (step S4 of Fig. 2). If modification of the parameter is not possible, the process is advanced to the LSP establishing procedure without performing merge (step S12 of Fig. 2).

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If the LSR is not the egress LSR, the parameter modification request is transmitted to the downstream LSR on the LSP to wait for the response (steps S24 to S26 of Fig. 3). When the rejection of modification of parameter is noticed from downstream LSR, rejection of modification of parameter is transmitted to the upstream LSR (step S29, S30 of Fig. 3).

When the LSR 102 receives the rejection of parameter modification from the downstream LSR, temporary setting of the parameter modification is released to transit to the LSP setting procedure without performing merge (steps S9 and S12 of Fig. 2).

When the LSR 102 receives the parameter modification response from the downstream LSR, the parameter modification is fixed to perform merge of the LSP (step S8 and S10 of Fig. 2). Then, an LSP setting response 402 is transmitted to the LSR 104 (step S11 of Fig. 2). As a result, setting of the LSP 302 to be merged to the LSP 301 by the LSR 102 with taking the LSR 104 as merge point, is completed.

The shown embodiment is characterized by modification of the parameter of the existing LSP so that the parameter of the LSP to be newly established may be accommodated in the existing LSP from the merge point to the egress LSR in addition to the case where the route is taken as common in the path from the merge point to the egress LSR, upon merging the LSP to be newly established into the existing LSP. By this, it becomes possible to merge the LSP with collateral parameter, such as requested bandwidth or the like, for example.

Furthermore, the present invention may be implemented in other way with taking Asynchronous Transfer Mode (ATM) network as a replacement of the MPLS network, a Virtual Channel (VC) as a replacement of the LSP, and an ATM switch as a replacement of the LSR.

The MPLS network is constructed with the LSRs 105 to 111.

Among the transfer route of the LSP 304, the tunneling LSP 303

Fig. 6 is an illustration for explaining a construction of the MPLS packet. In Fig. 6, there is shown the structure of an MPLS packet flowing on the LSP 304 between the LSR 107 and the LSR 109.

Note that the shim header 505 is applied only between the LSR 107 and the LSR 109 to be used as the transfer route in which the tunneling LSP 303 is used as the transfer assignment. In the other sections, the shim header 504 appears at the top stack entry.

Let us consider the case that the LSP from the LSR 106 to the LSR 110 via the LSR 107 is initiated. Here, the initiated LSP includes collateral parameters, such as requested bandwidth or the like.

The LSR 106 transmits the LSP setup request 405 to the LSR 107.

At first, the LSP 304 checks whether the LSR 107 uses the tunneling LSP as a part of the transfer route (step S43 in Fig. 7). As a result of checking at step S43, if the LSP 304 uses the tunneling LSP as a part of the transfer route at the LSR 107, modification of the parameter of the tunneling LSP is negotiated in the similar manner as step S13 of Fig. 2 so that the newly established LSP may be accommodated (step S45 in Fig. 7). In Fig. 4, since the LSP 304 uses the tunneling LSP 303 as a part of the transfer route at the LSR 107, the process is moved from step S43 to S45.

At step S45, when modification of parameter is successful, exchange of message relating to modification of parameter is performed in sequentially order of transmitting the parameter modification request 407 from the LSR 107 to the LSR 108, transmitting the parameter

As a result of process at step S45, if the modification of parameter is not successful, the procedure to establish the LSP is executed in place of executing merge (step S52 in Fig. 7). If the modification of parameter is successful, the parameter of LSP304 itself is modified (step S47 in Fig. 7).

As a result of checking at step S43, if the LSP 304 does not use the tunneling LSP as a part of the transfer route in the LSR 107, the process is transit to step S47 directly to perform modification of parameter of the LSP 304 (step S47 in Fig. 7).

As a result of process at step S47, if the modification of parameter is not successful, the process is moved to the procedure for setting

Next, discussion will be given for the operation when the LSP having the common route to the egress LSR does not exist in the LSR 107 upon receipt of the LSP setup request 405 at step S42. Fig. 5 shows the case where the LSR 106 initiates the setup request of the LSP to the LSR 111 via the LSR 107.

As a result of checking at step S44, if the route up to the terminal end of the tunneling LSP 303 as set in the LSR 107 cannot be a part of the route of the LSP to be newly established, attempt to make the newly established LSP to be accommodated in the tunneling LSP and the procedure to establish the LSP is executed (step S52 in Fig. 7).

As a result of checking at step S44, if the route up to the terminal end of the tunneling LSP 303 as set in the LSR 107 can be a part of the route of the LSP to be newly established, which corresponds the

At step S46, exchange of the message relating to modification of parameter is similar to the same as the case where the modification of parameter is successfully at step S45.

As a result of the step S46, if the modification of parameter is not successful, attempt to accommodate the LSP to be newly established in the tunneling LSP 303 and process is transit to the procedure for establishing the LSP (step S52 in Fig. 7). If modification of parameter is successful, the newly established LSP is accommodated in the tunneling LSP 303 to transmit the LSP setup request to the LSR 109 as terminal end of the tunneling LSP 303 (steps S48 and S49 in Fig. 7).

If the setting of the LSP fails at step S49 and subsequent steps, accommodation to the tunneling LSP 303 is released at step S48 to

accommodate the newly established LSP without negotiation, negotiation is not performed and the newly established LSP is accommodated in the tunneling LSP. Namely, step S46 of Fig. 7 is omitted.

On the other hand, in the shown embodiment, discussion has been made under the premise that the tunneling LSP is preliminarily set. However, when the tunneling LSP is not present, the newly established LSP may have a part of the route common to existing route. At this time, in the common portion, the tunneling LSP is newly set. Then, in the newly set tunneling portion, the newly established LSP may be merged to the existing LSP.

Namely, in this case, at step S46 of Fig. 7, instead of negotiating modification of parameter of the tunneling LSP, the tunneling LSP is set so as to accommodate both of the newly established LSP and the existing LSP.

On the other hand, while two level of label stack is used in the shown embodiment, this can be extended to arbitrary number of levels. Namely, ~~the present invention is applicable for the case where~~ the tunneling LSP is used as a part of the route of another tunneling LSP to stack arbitrary number of stacks.

Furthermore, the present invention may be implemented in other way with taking Asynchronous Transfer Mode (ATM) network as a replacement of the MPLS network, a Virtual Channel (VC) as a replacement of the LSP, and an ATM switch as a replacement of the LSR. In this

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Next, the LSR 102 transmits the parameter modification request 403 to the LSR 103. In the parameter modification request 403, the value of 15 Mbit/sec. as the reserved bandwidth of the LSP 301 to

The LSP 103 upon receipt of the parameter modification request makes judgment whether or not the reserved bandwidth of the LSP 301 can be modified to 15 Mbit/sec. If modification is possible, the reserved bandwidth of the LSP 301 is modified to 15 Mbit/sec. Then, parameter modification response 404 is returned to the LSR 102.

The LSR 104 upon receipt of the LSP setup response 402 fixes the temporarily set bandwidth reservation, and merges the newly established LSP to the LSP 301 to terminate setting of the LSP. Namely, the LSP 302 from the LSR 105 as the starting point to be merged to the LSP 301 at the LSR 102 is set. The LSP 302 may have the reserved bandwidth 5 Mbit/sec. and has the reserved bandwidth 15 Mbit/sec. from the LSR 102 to the LSR 103.

Fig. 8 is an illustration for explaining the second embodiment of the present invention. Discussion will be given hereinafter for the second embodiment of the present invention with reference to Fig.

The LSR 112 transmits the LSP setup request (label request message) 419 to the LSR 114. In the LSP setup request 419, information indicating that the transit node is LSR 114 and the destination is LSR 118 and traffic parameter as 20 Mbits/sec. as the bandwidth to be reserved.

Here, check is performed whether or not the LSP that may have the route to the egress LSR 118 in common with the newly established LSP is present. Namely, check is performed whether or not the LSP reaching the step 118 via the LSR 115 and the LSR 116 ~~is present or~~ not. Here, such LSP is not present.

Therefore, check is again performed whether the route at the terminal point of the tunneling LSP set in the LSR 114 can be a part of the transit route of the LSP to be set. Here, check is performed whether or not the tunneling LSP having the terminal point at the LSR 116 via the LSR 115, is present. Accordingly, the tunneling LSP

307 is selected as candidate.

Next, check is performed whether or not the tunneling LSP 307 has the parameter of the reserved bandwidth. If the tunneling LSP 307 has the reserved bandwidth as parameter, the reserved bandwidth is modified to 50 Sec/sec. as sum of 30 Mbits/sec. and 20 Mbits/sec. in the similar procedure in the first embodiment of the present invention.

If modification of the reserved bandwidth of the tunneling LSP 307 is successful, setting of the LSP is performed through the sequence of process that the LSP setup request 421 is transmitted from the LSR 114 to the LSR 116, the LSP setup request 423 is transmitted from the LSR 116 to the LSR 118, the LSP setup response 424 is transmitted from the LSP 118 to the LSR 116, the LSP setup response 422 is transmitted from the LSR 116 to the LSR 114, and the LSP setup response 420 is transmitted from the LSR 114 to the LSR 112.

Upon transmitting the LSP setup request 423 from the LSR 116 to the LSR 118, the route to the LSR 118 is calculated by the OSPF to see that the next hop is the LSR 118. Finally, the LSP 309 is set with taking the LSR 112 as start point and the LSR 118 at terminal point via the LSR 114 and the LSR 116.

Among the transfer route of the LSP 309, between the LSR 114 and the LSR 116 as a portion to pass the backbone 4, the tunneling LSP 307 is used. In the backbone 4, for the packet transferred through

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On the other hand, 20 Mbits/sec. is set as reserved bandwidth in the LSP 30. In the tunneling LSP 307, 50 Mbits/sec. as the reserved bandwidth as a sum of the 30 Mbits /sec. of the reserved bandwidth of the LSP 308 and 20 Mbits/sec. of the reserved bandwidth of the LSP 309 is set.

In the backbone 4, the LSP 308 and the LSP 309 entering into the area 2 is merged by the tunneling LSP 307, and is branched to the LSR 117 and the LSR 118 as exiting to the area 3.

As set forth above, upon performing merge of the LSP, merge operation is performed after modification of collateral parameter owned by the existing LSP for accommodating the newly established LSP. By this, it becomes possible to perform merge of the LSP having request bandwidth or the like which has not been merged conventionally. Thus, greater number of LSPs are merged to contribute for reduction of number of labels which is inherent in expansion of scale of the network.

On the other hand, by accommodating a plurality of LSPs with collateral parameters in the preliminarily set tunneling LSP, merge is possible only in the portion of the tunneling LSP. For example, even when most of the LSPs pass the same portion in the network, merge cannot be performed unless the route up to the egress LSR is common.

In contrast to this, according to the present invention, by setting the tunneling LSP for the portion where a plurality of LSPs pass the common route, merge becomes possible in the portion where the tunneling LSP is present.